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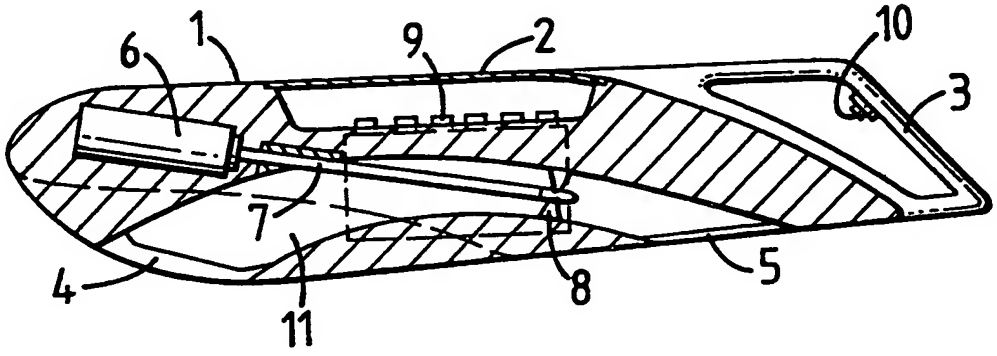
(54) Title: PROPULSION DEVICE FOR SWIMMERS



(57) Abstract

A propulsion device for moving a person over a water surface comprises a hull (1) containing propulsion means in the form of a propulsion device (8) and drive means (6, 7) for the propulsion device (8) and also having handles (3) for the person to grip so that a person can be towed in a prone position over a water surface. The propulsion device (8) is contained in a through water channel (11) extending in the fore to aft direction for creating a water flow through the channel (11) whereby to propel the device across a water surface. The channel (11) has a downward direction at its exit end when viewed in the "straight ahead" position of the hull so that steering of the device can be achieved by tilting the device through the handles (3) about a fore to aft axis. The drive means comprises at least one permanent magnet motor (6) energised from a battery pack (9) of secondary cells.

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PROPULSION DEVICE FOR SWIMMERS

This invention relates to propulsion devices for moving a person over a water surface.

According to the invention the propulsion device comprises a hull containing propulsion means and having handles whereby the device is designed to tow a person in a prone position over a water surface.

The device is designed to give the sensation of body surfing (surfing without a surfboard) and without the necessity of being skilled in the art of surfing and without having to seek out good surfing beaches. Body surfing is exciting as the modest speeds developed when coming in "on a wave" produce heightened sensations of speed due to the person's body being directly in contact with the water.

The hull is preferably provided with a through water channel in the fore to aft direction and containing an impeller or other means for creating a water flow through the channel whereby the device is propelled across a water surface. The inlet end and/or the exit end of the water channel preferably has a downward direction when viewed in the "straight ahead" position of the hull whereby steering of the device out of the "straight ahead" position can be achieved by tilting the device through the handles about a fore to aft axis.

The drive for the device preferably comprises a high power/weight ratio D.C. electric motor or motors supplied

from a high energy battery or batteries housed within the hull. The motor may be of the permanent magnet type having neodimium iron boron magnets. The battery is for example a nickel cadmium battery.

One advantageous arrangement comprises a plurality of motors mechanically connected together to drive a common propulsion means, the motors being electrically connected to be independently energised from respective battery packs.

Examples of propulsion device in accordance with the invention will now be described by way of example with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a sectional elevation of a first form of the device,

Figure 2 is a half plan view of the device of Figure 1 taken on a horizontal plane,

Figure 3 is a scrap sectional view of a detail of the device of Figure 1,

Figure 4 is a schematic top plan view of an alternative form of device, and

Figure 5 is a block diagram of the electrical circuitry used in the device of Figure 4.

Referring to Figures 1 to 3, the propulsion device comprises a hull in the form of a smooth surfaced pillow shaped buoyant body 1 provided with handles 3 at the rear end. The body 1 has a through water channel or duct 11

extending in the fore to aft direction from an entry port 4 to an exit port 5. An impeller 8 is located in the duct 11 and extends transversely of it so that when the impeller 8 is driven, water is drawn through the duct to create thrust for propelling the device forwards. The duct 11 is of substantially circular cross-section in the region of the impeller but not of constant area or necessarily of circular cross-section elsewhere. The duct 11 curves in the form of an arc from the front to the rear of the device i.e. in the fore to aft direction so that it has a downward direction at the ports 4 and 5 in the "straight ahead" position of the body 1 shown in Figures 1 to 3.

A high powered electric motor 6 housed within the body 1 drives the impeller 8 via a shaft 7. The motor 6 is powered by a battery pack comprising secondary cells 9 which are disposed within the body 1 of the device. The cells 9 are accessible for easy replacement or maintenance through a watertight hatch 2. Flow of current to the motor 6, and therefore thrust produced is controlled by two watertight buttons 10, located one each side on the handles 3. These buttons 10 send signals to a custom made circuit board (not shown) which could be at any convenient location within the body 1. Both of the buttons 10 need to be depressed to sustain a constant speed - releasing one button momentarily causes the speed to be ramped up to maximum and releasing the other causes a corresponding ramping down of the speed so that any desired speed

between minimum and maximum can be obtained and subsequently held by resuming pressure on both buttons. Releasing both buttons simultaneously causes all power instantly to be cut off from the motor bringing the device quickly to a halt thus preventing any runaway.

Steering is effected by rolling or tilting the device about its longitudinal i.e. its fore to aft axis. When the device has a level "straight ahead" attitude water leaving the exit port 5 provides downward and rearward components of thrust. When the device is tilted a lateral component is added to the thrust and causes the device to deviate to left or right with respect to the operator depending on the direction and tilt.

The chosen method of propulsion by ducted impeller and the method of steering by angling the thrust components result in a perfectly smooth and rounded outline to the device with no extraneous protrusions that could injure the operator or other swimmers. Even the handles 3 could be recessed within the overall hull profile if desired although this might reduce operator comfort slightly. It is also essential that the drag induced by the operator acts behind the exit port 5 and is greater than the drag from the hull surfaces in front of this point in order to obtain correct steering action.

Theoretical calculations backed up by full scale water tank tests have confirmed that sufficient power can be obtained from modern high efficiency DC motors and

modern secondary storage cells to allow a reasonable operating time at full power on one charge.

Referring now to Figures 4 and 5, the same reference numerals have been used as in Figures 1 to 3 to designate corresponding parts. The body 1 is generally of the same smooth and rounded outline as shown in Figures 1 to 3 and the duct 11 extends through the body in similar manner to that shown in Figures 1 to 3. The handles of the device of Figures 4 and 5 are provided by a rotatable bar 12 furnished with hand grips 13. This bar 12 is connected by a bowden cable 14 which passes through the body 1 via a watertight gland and operates an input control unit 15 in the form of a rheostat situated in a convenient location within the body 1 to control the power output of the device. A return spring 16 ensures that power is shut off if the operator lets go of the hand grips 13.

The device of Figures 4 and 5 has two or more electric motors 6 mechanically coupled to drive the impeller 8 via the shaft 7, the coupling being by means of toothed belts 16 or ordinary V belts. By this means, two or more battery packs 17 (Figure 5) can be used each of which is used independently of the other to energise a respective motor 6, and the charge drawn from each pack will be automatically equalised by the "back EMF effect". This would not be the case if two or more motors 6, each having an independent battery pack were to drive independent impellers. The advantage of separate battery

packs in this application is that high levels of power can be drawn in total without exceeding a dangerously high voltage (around 50 volts) which would be the case if all the cells were connected in series, and without having to connect cells in parallel which is not recommended by battery manufacturers.

In order to take advantage of this system, it is necessary to have a means of switching or continuously variably controlling the motor/battery systems so that on the power side they are electrically isolated from each other. One means of doing this is shown by the block diagram of Figure 5.

Referring more particularly to Figure 5, each of the motors 6 is powered from a respective one of the battery packs 17 via a respective power output stage 18. Each power output stage 18 provides a pulsed power output to its motor 6 the mark to space ratio of the pulses being varied to vary the power output. The pulse mark to space ratio is controlled by a respective power driver 19 which is energised from a respective one of the battery packs 17 via a low voltage detect unit 20. The unit 20 serves to detect when the associated battery pack 17 is at a predetermined low state of charge to prevent complete discharge of the associated battery packs 17. It also serves to warn the operator of the low state of charge so that he is still able to return to base at low power levels. Each power driver 19 produces a pulsed output

corresponding to that which is to be produced from its associated power output stage 18. The pulsed output from each power driver 19 provides the control input to the power output stage 18 connected to it; thus each power output stage 18 is in effect a power amplifier. The mark to space ratio of the pulse outputs from the power drivers 19 is controlled by a pulse width modulator 21 and variation of this mark to space ratio will vary the mean power supplied to the motors 6 and hence the speed at which the device is propelled through the water. The pulse width modulator 21 is in turn controlled by the rheostat 15 whose setting is determined by the position in rotation of the twist grips 13 and hence the bar 12. The rheostat 15 and the pulse width modulator 21 are common to both motor control circuits so that each motor 6 has the same control applied to it.

The steering of the device is by tilting the body 1 as described with reference to Figures 1 to 3.

CLAIMS

1. A propulsion device for moving a person over a water surface comprising a hull (1) containing propulsion means in the form of a propulsion device (8) and drive means (6,7) for the propulsion device (8), and having handles (3,12,13) for the person to grip, whereby the device is designed to tow a person in a prone position over a water surface.

2. A device according to claim 1, wherein the hull (1) has a through water channel (11) extending in the fore to aft direction and said propulsion device (8) is disposed within the channel (11) for creating a water flow through the channel (11) whereby the device is propelled across the water surface.

3. A device according to claim 2, wherein the inlet end (4) and/or the exit end (5) of the water channel (11) has a downward direction when viewed in the "straight ahead" position of the hull (1) whereby steering of the device out of the "straight ahead" position can be achieved by tilting the device through the handles (3,12,13) about a fore to aft axis.

4. A device according to any preceding claim, wherein the drive means (6,7) include one or more electric motors (6) energised from one or more battery packs (9,17) housed in the hull (1).

5. A device according to claim 4 wherein the or each said electric motor (6) is of the permanent magnet type

having neodimium iron boron magnets.

6 A device according to claim 4 or 5, wherein the drive means comprises at least two electric motors (6) energised independently from respective battery packs (17) and mechanically connected to drive a common propulsion device (8).

7. A device according to claim 6, wherein the power supplied to each motor (6) is controlled by means operable at the handles (3,12,13) to operate an input control unit (15) common to the control circuits (18,19,20,21) of each motor.

8. A device according to claim 7 wherein said control circuits (18,19,20,21) include a common pulse width modulator (21) controlled from the input control unit (15).

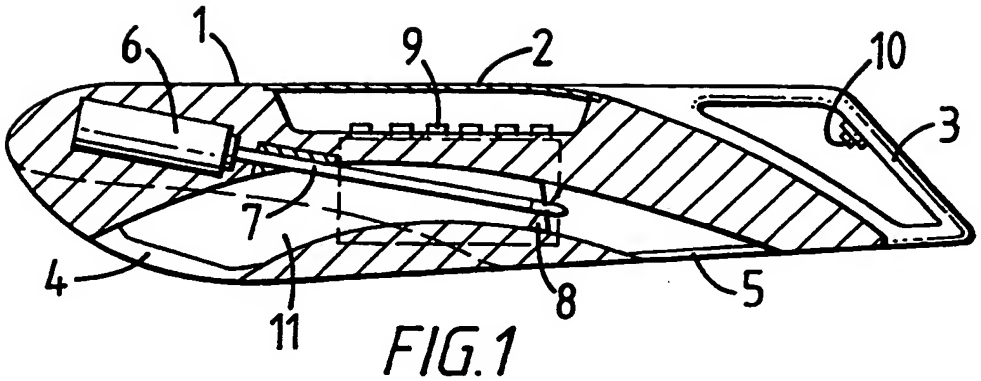

FIG.1

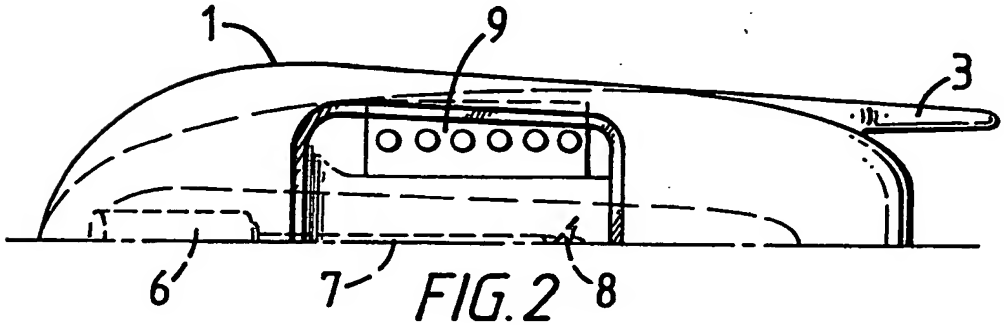

FIG.2

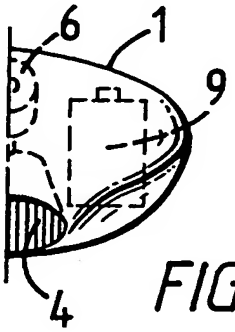

FIG.3

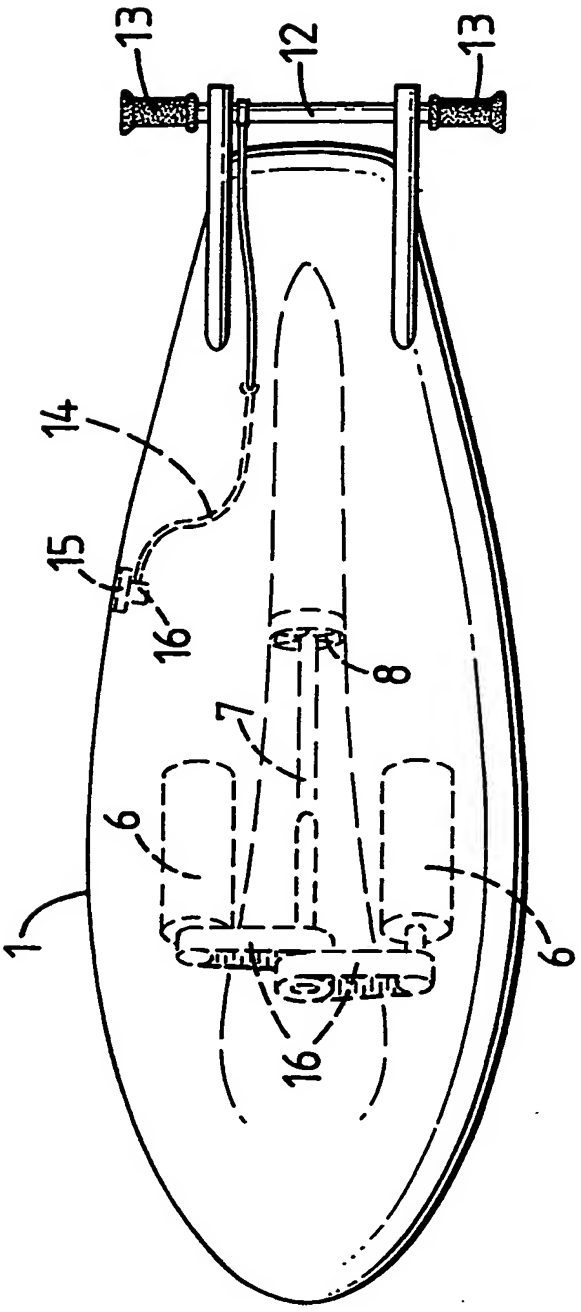

FIG.4

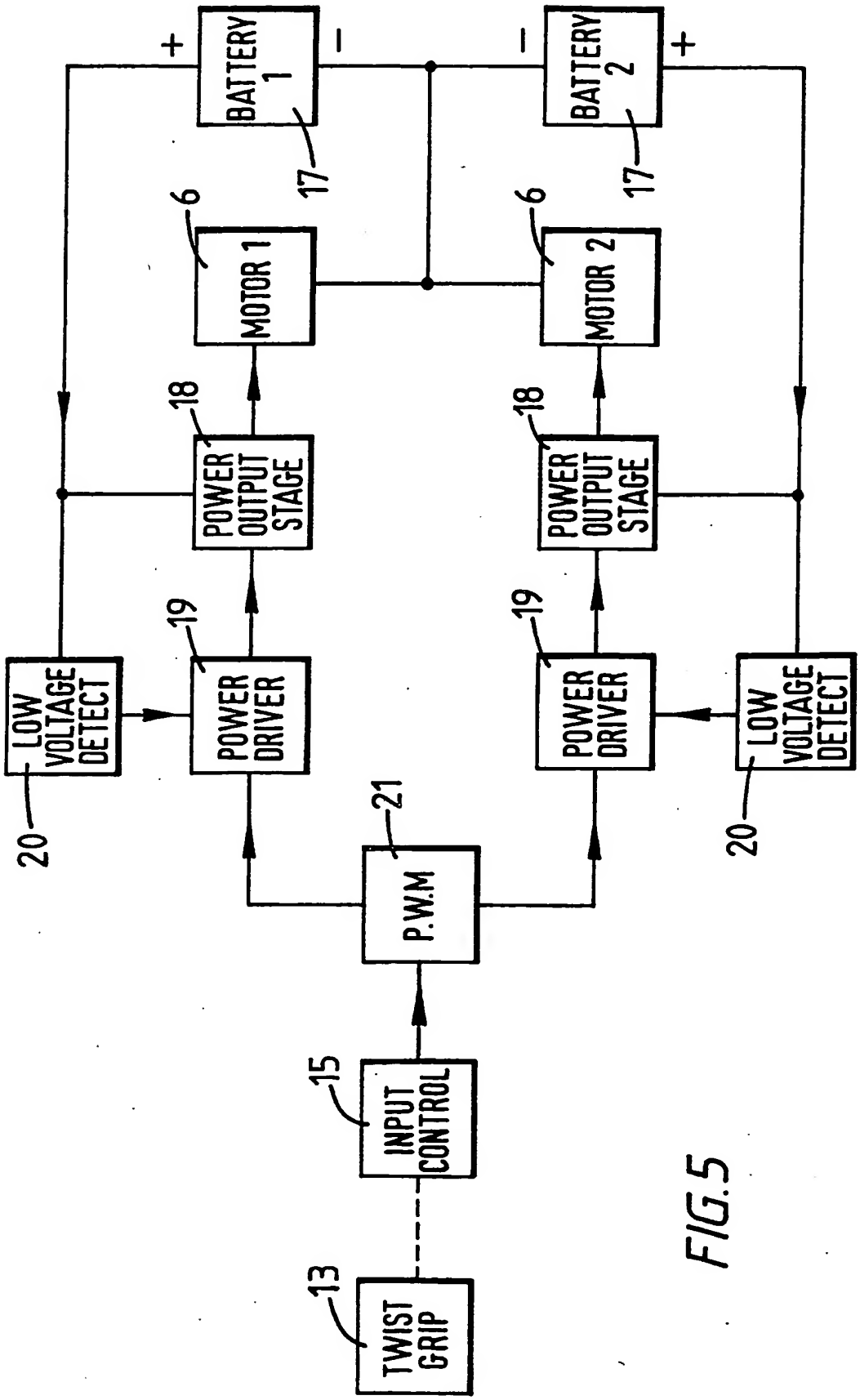
BATTERY 1
BATTERY 2
+
−
17
6
MOTOR 1
MOTOR 2
18
POWER OUTPUT STAGE
19
POWER DRIVER
LOW VOLTAGE DETECT
20
21
P.W.M
15
INPUT CONTROL
13
TWIST GRIP

FIG.5

INTERNATIONAL SEARCH REPORT

PCT/GB 91/01007

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A63B35/12

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A63B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[10]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	FR,A,1 564 945 (CHAPOUX) April 25, 1969 see page 1, left column, line 1 - right column, line 15; figures 1-3	1-3
X Y	DE,C,880 565 (LEHMANN) June 22, 1953 see page 2, line 41 - line 78; figures 1-2 see page 3, line 15 - line 28	1-4 5
X	GB,A,1 545 222 (MCLEOD) May 2, 1979 see page 1, line 62 - line 66; figures 1-3 see page 2, line 21 - line 33 see page 2, line 66 - line 67	1-4
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
30 SEPTEMBER 1991	16. 10. 91
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Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 13, no. 338 (E-795)(3686) July 28, 1989 & JP-A-1 99 457 (SEIKO EPSON CORP) April 18, 1989 see the whole document	5
A	US,A,3 789 792 (SMITH) February 5, 1974 see column 3, line 27 - line 33; figures 1-4	6

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9101007
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE-C-880565		None	
GB-A-1545222	02-05-79	None	
FR-A-660056		None	
US-A-3543712	01-12-70	None	
US-A-3789792	05-02-74	None	